Vol. 7. MARCH, 1920 No. 3.

JOURNAL
OF THE
BOSTON SOCIETY
OF
CIVIL ENGINEERS

Published monthly, excepting July and August, by the Society,
715 Tremont Temple, Boston, Massachusetts.

Entered as second-class matter, January 15, 1914, at the Post Office at Boston, Mass., under Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 16, 1918.

Subscription Price, $4.00 a year (Ten Numbers)
50 Cents a Copy

Copyright, 1920, by the Boston Society of Civil Engineers.

BOSTON SOCIETY OF CIVIL ENGINEERS

OFFICERS, 1919-1920

PRESIDENT

LEONARD METCALF

VICE-PRESIDENTS

LEONARD C. WASON
(Term expires March, 1920)

ROBERT SPURR WESTON
(Term expires March, 1921)

SECRETARY AND LIBRARIAN

S. EVERETT TINKHAM

TREASURER

FRANK O. WHITNEY

DIRECTORS

JOHN L. HOWARD
(Term expires March, 1920)

EDWIN H. ROGERS
(Term expires March, 1920)

STURGIS H. THORNDIKE
(Term expires, March, 1921)

ARTHUR S. TUTTLE
(Term expires March, 1921)

PAST PRESIDENTS
(Members of the Board)

RICHARD A. HALE
GEORGE C. WHIPPLE
CHARLES M. SPOFFORD

NOMINATING COMMITTEE

EDMUND M. BLAKE
CHARLES T. MAIN
ARTHUR T. SAFFORD
(Term expires March, 1920)

DAVID A. AMBROSE
HAROLD K. BARROWS
FRANK A. MARSTON
(Term expires March, 1921)

PAST PRESIDENTS (Members of the Committee)

FREDERIC H. FAY
HARRISON P. EDDY
CHARLES R. GOW

Editor — WILLIAM L. BUTCHER
715 Tremont Temple, Boston

Vol. VII MARCH, 1920 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPER IN THIS NUMBER.

"Small Sewage Pumping Stations." Eugene F. Leger.

Reprints from this publication, which is copyrighted, may be made provided full credit is given to the author and the Society.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETINGS.

BOSTON, February 18, 1920. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order by the President, Mr. Leonard Metcalf, at 7.50 o'clock.

There were 105 members and visitors present.

The record of the last meeting was read and approved.

The Secretary reported, for the Board of Government, the election of Mr. Herman Scott Price to membership in the grade of member.

The committee, Messrs. H. B. Wood, E. S. Smilie and E. P. Adams, appointed to prepare a memoir of Edward A. Buss, submitted its report and by vote it was accepted and ordered printed in the JOURNAL of the Society.

The deaths of the following members were announced: Frank L. Fuller, who died January 30, 1920; and R. Winthrop Pratt, who died February 2, 1920. By vote, the President was requested to appoint committees to prepare memoirs. The members of the committees selected by the President are: On memoir of Mr. Fuller, John C. Chase; on memoir of Mr. Pratt, Morris Knowles and George W. Fuller.

On motion of Mr. Rogers, the following vote, passed at the last meeting, was passed a second time, as required by the By-Laws, by a unanimous vote:

"*Voted:* That the entire income of the Permanent Fund for the current year be appropriated and placed at the disposal of the Board of Government for use in payment of the expenses of the Society so far as in their judgment it is deemed advisable."

The President then submitted the report of the Committee on Compensation of Engineers made to the Board of Government, which had been printed and sent to the membership of the Society with the notice of this meeting; and called on Col. Charles R. Gow, the chairman of the committee, for any explanations he cared to make. Colonel Gow responded briefly with an account of the work of the committee and the reasons for its conclusions. As the time for taking up the literary exercises of the meeting, as provided in the By-Laws, has nearly arrived, on motion of Mr. Morphy it was voted that when the meeting adjourned it be to next Wednesday evening, February 25, at eight o'clock, and that the adjourned meeting be devoted to discussion and action on the report of the Committee on Compensation of Engineers.

The President then presented Mr. Edmund M. Blake, a member of the Society, who gave a most interesting account of the Douglas Fir Industry on the Pacific Coast and Its Preservative Treatment by the Perforating Process. The address was very fully illustrated with lantern slides, and a complete working model of the drum of the perforating machine was shown.

Mr. Blake was followed by Mr. Chester J. Hogue, a former member of the Society, who spoke particularly of Douglas fir for structural uses.

Mr. Lowry Smith, assistant engineer of maintenance, Northern Pacific Railroad, was then introduced and spoke briefly of methods of creosoting Douglas fir and other timber.

Colonel Gow, in offering a motion for a vote of thanks to the speakers of the evening, expressed his regrets that Mr. Blake was automatically debarred from the vote because he possessed the greater honor of being a member of the Society. The vote extending the thanks of the Society to Mr. Hogue and Mr. Smith for their entertaining addresses was then unanimously adopted.

The meeting then adjourned to next Wednesday evening, at eight o'clock.

S. E. Tinkham, *Secretary.*

Boston, February 25, 1920.—The adjournment of the last regular meeting of the Society was called to order this evening at Chipman Hall, Tremont Temple, at 8.05 o'clock, by the President, Leonard Metcalf.

There were present 78 members.

The President stated the last meeting was adjourned to this date for the discussion of the report of the Committee on Compensation of Engineers, and he asked the Secretary to open the discussion by reading communications which had been received from members of the Society.

The Secretary then read letters from X. Henry Goodnough, Edward Wright and Kenneth P. Armstrong.

The discussion was continued by Lewis E. Moore, Frank B. Walker, John E. L. Monaghan, Harrison P. Eddy, Charles R. Gow, Frank P. Hodgdon, Luis G. Morphy, Charles M. Spofford, Edgar S. Dorr, Edward P. Adams and others.

Mr. Eddy moved: That the report of the Committee on Compensation of Engineers be referred back to the committee with the request that further consideration be given to the schedule of salaries to be recommended, to the wording of the report, and to such other matters as the committee may deem advisable.

Mr. Gow felt that it would be better to refer the report to a new committee on which there should be adequate representation of publicly employed engineers, and that personally it would not be possible for him to do any work on the committee at present for the reason that he would leave early next week on a trip, to be absent some six weeks or more. He therefore moved an amendment to the motion to the effect that the report be referred to a new committee.

On a vote being taken on Mr. Gow's amendment, it was lost (15 in favor and 25 against).

Mr. Eddy's original motion was then adopted by a unanimous vote.

Mr. Eddy then offered the following motion, and moved its adoption:

> "That this meeting commend to the favorable consideration of the Committee on Compensation of Engineers the suggestions that:
>
> "(*a*) Government, state and municipal engineering service should command compensation measurably greater than the equivalent service rendered to other parties.
>
> "(*b*) There should be a substantial vertical rise from the upper limit of one grade to the lower limit of the next higher grade.
>
> "(*c*) An effort should be made to formulate and secure governmental, state and municipal adoption of a plan for the automatic increase in compensation, within each grade of service and between the limits fixed, said increase to be dependent upon and in a measure commensurate with the length of the term of service.
>
> "(*d*) The schedule of salaries advocated by Engineering Council is reasonable, just to employer and employee, and should be endorsed by this Society, and such endorsement I believe requires certain formalities.
>
> "(*e*) In cases where the public authorities are unwilling to grant increases in compensation sufficient to provide salaries equal to the schedule of Engineering Council, this Society should approve an increase equivalent to about 40 per cent. in all grades of service — with the distinct understanding that such increase is to constitute simply a first step, and that further increases should be forthcoming from year to year as rapidly as possible until the schedule of Engineering Council shall have been put into effect."

On a vote being taken, the motion was adopted.

Mr. Morphy said he would like to obtain the sense of the meeting in regard to the approval of Senate Bill No. 196, and on a call for the provisions of the bill the President read the bill in full.

Mr. Eddy moved: That it is the sense of this meeting that this bill should be supported and that the Board of Government should provide that the Society be represented at any public hearing upon the bill. Mr. J. L. Howard moved, as an amendment to the motion, that it is the sense of the meeting that the Board of Government be authorized to support the schedule of Engineering Council in place of that recommendation by the bill. On a vote being taken, the amendment was adopted.

Mr. Eddy's motion as amended was then adopted.

By a unanimous vote, the thanks of the Society were tendered to the Committee on Compensation, for its work.

Adjourned.

S. E. TINKHAM, *Secretary*.

BOSTON, February 11, 1920. — The Sanitary Section of the Boston Society of Civil Engineers held a special meeting this evening in the Society Library, Tremont Temple. The meeting was called to order by the chairman, Edgar S. Dorr, at 7.45 P.M.

The record of the December meeting was approved as printed in the Society JOURNAL.

The chairman introduced Mr. Eugene F. Leger, of the Power Equipment Company, who gave a very interesting talk on "Small Sewage Pumping Stations." Mr. Leger related the difficulties that had been encountered in the pumping of sewage, and described in detail the latest practice in pump design.

On motion of Mr. Marston, a rising vote of thanks was given to the speaker, for his courtesy in presenting this paper.

Adjourned at 9.30 P.M. Members present, 32.

JOHN P. WENTWORTH, *Clerk*.

APPLICATIONS FOR MEMBERSHIP.

[March 17, 1920.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

BADGER, ALBERT WILLIAM, Hyde Park, Mass. (Age 39, b. Roxbury, Mass.) Educated in public schools. With William O. Badger on general survey work; assistant engineer, town of Hyde Park, 1905 to 1912; assistant engineer, City of Boston, in sewer and paving divisions, Public Works Department, from 1912 to date. Refers to B. F. Bates, E. S. Dorr, C. S. Drake, G. W. Hamilton, J. E. L. Monaghan and E. F. Murphy.

COLE, HAROLD STEPHEN, Framingham, Mass. (Age 23, b. Ashland, Mass.) Educated in the public schools and International Correspondence School. Experience, four months in drafting room of International Engineering Works, Framingham, Mass.; about three years draftsman with Guilee Engineering Co., Framingham; about one year draftsman with Mead-Morrison Co., East Boston. With the 6th Regiment during the war, discharged in April, 1919. Returned to Mead-Morrison Co., and remained till August, 1919; with French & Hubbard, civil engineers, Boston, till November, 1919, and since then with U. S. Color & Chemical Co., Ashland, Mass. Refers to F. H. Clark, C. E. Haberstroh, W. W. Locke and J. F. Wilbur.

COLEMAN, GEORGE STEPHEN, Boston, Mass. (Age 35, b. South Framingham, Mass.) Student at Boston Mechanic Arts High School, 1900 to 1904, and at Massachusetts Institute of Technology, 1904 to 1907; rodman, Charles River Basin Commission, July, 1907, to June, 1910, and Metropolitan Park Commission, June, 1910, to July, 1911; transitman, Public Works Department, Boston, July, 1911, to 1913, and senior transitman, same department, till 1915; assistant engineer, same department, to present. Refers to D. A. Ambrose, J. E. Carty, E. S. Dorr, J. N. Ferguson and J. E. L. Monaghan.

Connor, John Edward, Boston, Mass. (Age 53, b. Maplewood, Mass.) Educated at Maplewood Grammar School and Boston English High School; took course in Boston Evening Drawing School and courses in mathematics under private tutor. Inspector in Sewer Service, City of Boston, 1900 to 1904; draftsman, City of Boston, 1904 to 1910; designer and draftsman, City of Boston, 1910 to 1918; designer, personal office, Q. M. C., U. S. Army, 1918 to 1919, and at present time designer and draftsman, City of Boston. Refers to T. F. Bowers, E. S. Dorr, C. S. Drake, D. P. Kelley, R. J. McNulty and J. E. L. Monaghan.

Ellis, Richard Henry, North Adams, Mass. (Age 27, b. Lawrence, Mass.) Graduate Dartmouth College, degree of S.B. in 1916; while in college was enrolled as member of Thayer School of Civil Engineering. In 1916 was draughtsman with George Adams, architect; and since September, 1916, engineer and superintendent of Board of Public Works of North Andover, Mass., in charge of maintenance and construction of water works and of the sewer system. Refers to J. R. Baldwin, H. K. Barrows, H. W. Clark, R. A. Hale and A. D. Marble.

Fraser, Charles Edward Kingston, Oyster Bay, N. Y. (Age 42, b. England.) Graduate of International Correspondence School, 1910. From 1901 to 1907 engaged in landscape engineering; from 1907 to April, 1908, inspector for Engineer Corps, Pennsylvania Tunnels, New York to Long Island City; from April, 1908, to July, 1916, engaged in landscape engineering and construction; from July, 1916, to April, 1917, engineer of construction, All Saints Church, Peterboro, N. H.; from April, 1917, to February, 1919, commissioned officer, Corps of Engineers, U. S. Army, discharged as captain, commanded reconstruction of Aprémont, St. Mihiel Road, Flirey Essey Road, and assisted on construction of Le Réné Forest and Mandras Road. Battalion citation for efficiency. Has executed plans for various architectural firms of Boston and New York. At present engaged in business for himself as civil and landscape engineer. Elected an associate of the Society, December 20, 1916, and now desires to be transferred to grade of member. Refers to G. P. Connolly, J. F. A. Giblin, A. L. Shaw, G. F. Webb and A. D. Weston.

Haskell, George Freeman, Boston, Mass. (Age 46, b. Boston, Mass.) Educated Boston English High School, Class 1892. From 1893 to 1895, employed as rodman and transitman by H. T. Whitman, C.E.; from 1895 to 1911 with surveying division, City of Boston, as transitman in charge of surveying party, and since February, 1911, has been in designing room of sewer service, City of Boston. At present, assistant engineer, Boston Public Works Department, Sewer Service. Refers to E. S. Dorr, Channing Howard, D. P. Kelley, R. J. McNulty, J. E. L. Monaghan and F. O. Whitney.

Hoar, William V. P., Dorchester, Mass. (Age 37, b. Boston, Mass.) Graduate Mechanic Arts High School, Boston, in 1901, and completed course in civil engineering in International Correspondence School about 1908. With Aspinwall & Lincoln as rodman and transitman, 1901 to 1903; with Metropolitan Park Commission in same position till 1907; with City of Boston, sewer service, in same position till 1910 and since 1910 assistant engineer in Boston Sewer Service. Refers to E. S. Dorr, C. S. Drake, D. P. Kelley, F. A. Lovejoy and J. E. L. Monaghan.

Holmes, Frank Oscar, Boston, Mass. (Age 44, b. Newton, Mass.) With Aspinwall & Lincoln, Boston, October, 1895; Boston Transit Commission, January, 1896, to April, 1898; U. S. Volunteer Signal Corps (military service); Boston Park Dept., August, 1899, to January, 1900; Boston Transit Commission, June, 1900, to February, 1902; White Mountain Paper Company, June, 1902, to March, 1903; Mass. Highway Commission, April, 1903, to November, 1903; Boston Sewer Division, November, 1903, to May, 1906; Quartermaster's Dept., West Point (civil), July, 1906, to November, 1907; Paving Dept., Highway Division, Boston, August, 1908, to April, 1913; Permit Dept., Highway Division, Boston, April, 1913, to January, 1916; Boston Sewer Service, July, 1916, to May, 1918; Boston Highway Service, May, 1918, to March, 1919; Boston Sewer Service, March, 1919, to present. Now assistant engineer, Sewer Service, Public Works Dept., Boston. Refers to Joshua Atwood, T. F. Bowers, H. A. Carson, G. C. Emerson and C. R. Gow.

Lynch, Daniel Joseph, Dorchester, Mass. (Age 47, b. Charlestown, Mass.) Educated in Dorchester High School and International Correspondence School. Has had twenty-five years' experience on engineering work. Now assistant engineer, Public Works Dept., City of Boston. Refers to J. E. Carty, E. S. Dorr, C. S. Drake, J. E. L. Monaghan and E. F. Murphy.

Maloy, Walter A., Boston, Mass. (Age 39, b. Boston, Mass.) Graduated from Boston English High School. Attended Boston College two years, in 1909 took course in plane surveying and railroad engineering at Harvard College Engineering Camp, and, in 1911, took course in Mechanics of Materials at Franklin Union; from 1909 to 1912, with Boston Elevated Railway on Cambridge subway and Malden extension as instrumentman and chief of party; 1912 to 1918, with Boston Sewer Dept. as draftsman and designer; in 1918 was with the Cerro de Pasco Copper Corporation in Peru on geological and underground surveys; since 1919 and at present with Boston Sewer Dept. as draftsman and designer. Refers to T. F. Bowers, E. S. Dorr, C. S. Drake, D. P. Kelley, R. J. McNulty and J. E. L. Monaghan.

Moulton, Joseph Wendell, Augusta, Me. (Age 26, b. Barnet, Vt.) Graduated in civil engineering at University of Maine in 1917. Entered U. S. Geological Survey as junior engineer, July, 1916; was assigned to duty in New York State and transferred to Boston, August, 1918; entered U. S. Army in September, 1918; discharged December, 1918; returned to the Geological Survey, Washington office, December, 1918; reassigned to Boston office in February, 1919; transferred to Albany office, March, 1919; promoted to assistant engineer, July, 1919; returned to Boston office in August, 1919, and assigned to Augusta, Me., to coöperate with Maine Water Power Commission in the collection of stream flow data, in which work he is now engaged.

Refers to H. S. Boardman, G. C. Danforth, C. H. Pierce and M. R. Stackpole.

Murphy, Daniel A., Dorchester, Mass. (Age 37, b. Boston, Mass.) Graduate Boston Mechanic Arts High School in 1905, attended structural course, Lowell Institute, in 1907, and Franklin Union, 1914–15. With Purdy & Henderson, civil engineers, on structural steel work, 1904–05; City of Boston, Sewer Service, as rodman, 1905–06; Boston School House Commission as rodman, transitman and assistant engineer, from 1907 to date. Now assistant engineer with School House Commission. Refers to J. J. Casey, E. S. Dorr, C. S. Drake, F. A. Lovejoy, R. J. McNulty and J. E. L. Monaghan.

Norris, Clarence George, Hyde Park, Mass. (Age 53, b. Chelsea, Mass.) Graduate in civil engineering, Mass. Institute of Technology, Class of 1890. Assistant engineer, Louisville Div. P. C. C. & St. L. Ry., 1890 to 1896; 1896 to 1900, inspector and assistant engineer, Hyde Park Sewer Commission; 1900 to 1903, superintendent of streets, Hyde Park; 1904 to 1912, engineer for Town of Hyde Park, outside of sewers; 1904 to 1912, town engineer of Hyde Park, and from 1912 to present time, assistant engineer in sewer service and paving division, City of Boston. Refers to E. S. Dorr, C. R. Gow, E. A. W. Hammatt, F. A. McInnes, J. E. L. Monaghan, E. F. Murphy and C. W. Sherman.

Parker, Edwin S., Brookline, Mass. (Age 32, b. Minneapolis, Minn.) A student in civil engineering for two years at the University of California, but was obliged to leave before graduation on account of sickness. In addition to summer work while at college, his experience has been in office of Cram & Ferguson, in 1916; with H. F. Kellogg, architect, from May, 1917, to July, 1918, latter part of time in charge of office and engineering work; from December, 1918, to present time, with James E. McLaughlin, architect, as engineer on structural work. Refers to J. J. Casey, J. E. Hanlon, Linton Hart and H. L. White.

Patterson, Herbert Lamb, Boston, Mass. (Age 46, b. St. Stephens, N. B.) Educated in public schools and course in structures in Y. M. C. A. in 1902. Rodman, city surveyor's office, 1893–97; transitman, 1897–1907; assistant to engineer, School House Commission, 1907–10, and since 1910 engineer in charge, School House Commission. Refers to F. B. Bates, C. S. Drake, F. A. Lovejoy, F. M. Miner, J. E. L. Monaghan and F. O. Whitney.

Pike, Waldo Francis, Newton Highlands, Mass. (Age 27, b. Cambridge, Mass.) Graduate Mass. Institute of Technology, 1915, civil engineering course. From 1915 to March, 1916, with the New England Structural Company; March, 1916, to June, 1916, assistant bridge inspector, B. & M. R.R.; June, 1916, to October, 1916, structural draftsman, B. & M. R.R.; and from October, 1916, to present time with Fay, Spofford & Thorndike. For eleven months, 1917 and 1918, loaned to Turners Falls Power and Electric Company on design of power house; one month in 1919, loaned to Parker, Thomas & Rice, on design of steel building, and four months to C. T. Main on general building work. Elected a junior, March 21, 1917, and now desires to be transferred to grade of member. Refers to C. R. Berry, B. A. Bowman, B. A. Rich, H. F. Sawtelle, H. C. Thomas and S. H. Thorndike.

Pitman, Mark Edgar, Boston, Mass. (Age 37, b. East Boston, Mass.) Graduate, East Boston High School, 1899. Employed by Metropolitan Sewerage Commission as rodman and transitman, 1899 to 1903; City of Boston, sewer service as transitman and assistant engineer on surveys, design and construction sewers, from 1903 to present time. Refers to T. F. Bowers, E. S. Dorr, G. W. Hamilton, J. E. L. Monaghan and E. F. Murphy.

Reynolds, Kenneth Cass, Somerville, Mass. (Age 23, b. Somerville Mass.) Graduate of Tufts College in 1919, with B.S. degree in civil engineering. Has been with Fay, Spofford & Thorndike on field and office work since September, 1919. Refers to C. R. Berry, R. W. Horne, E. H. Rockwell, H. F. Sawtelle, R. C. Smith and W. D. Trask.

Sherman, Henry Arthur, Boston, Mass. (Age 46, b. West Lebanon, N. H.) Graduate Mass. Institute of Technology in 1897, mining engineering course. With Public Works Dept., City of Boston, 1897 to 1920, and at present assistant engineer, Sewer Service, City of Boston. Refers to T. F. Bowers, E. S. Dorr, C. S. Drake, G. W. Hamilton, F. A. Lovejoy and J. E. L. Monaghan.

Walker, Edward Lloyd, Framingham, Mass. (Age 45, b. Milford, Mass.) Graduate, Worcester Polytechnic Institute, 1897, in civil engineering. From 1897 to 1900, rodman and instrumentman with Metropolitan Water Board; 1900–02, draftsman, Pennsylvania & Northwestern R. R.; 1902–03, draftsman Jersey City Water Supply Co.; 1903–04, resident engineer with Hazen & Fuller, on construction of additional water supply for Meadville, Penn.; 1904–05, engineer in charge of party with National Board of Fire Underwriters; 1905–10, engineer in charge of designing and drafting division, New York City Aqueduct Commission; 1910–13, supervising engineer with Dept. of Water Supply, Gas and Electricity, New York City; 1914–15, division engineer, Water Supply Commission of Penn., and 1915 to date, assistant engineer with Fay, Spofford & Thorndike, principally on water works, valuation and design, except part of 1917–18, when he was with Monks & Johnson in connection with new destroyer plant at Squantum, Mass. Refers to A. O. Doane, F. H. Fay, A. D. Flinn, R. W. Horne, J. S. Lamson, J. W. Smith.

Young, Ernest Murdock, Boston, Mass. (Age 40, b. Cambridge, Mass.) Rodman, City of Boston, Sewer Service, from 1896 to 1903; transitman from 1903 to 1906; May and June, 1906, transitman on surveys, Mass. Highway Commission, and from July, 1906, to date, junior engineer, Boston Sewer Service, on sewer design, layout of separate system of drainage areas in charge of construction work, etc. Now assistant engineer in sewer service of City of Boston. Refers to E. S. Dorr, G. W. Hamilton, F. A. Lovejoy, J. E. L. Monaghan, E. F. Murphy and H. A. Wilson.

LIST OF MEMBERS.

ADDITIONS.

Budd, George, Jr. .... 28 Chester St., Lowell, Mass.

Price, Herman S.,
U. S. Geological Survey, Custom House Bldg., Boston, Mass.

CHANGES OF ADDRESS.

Barnes, Rowland H. . . . . Nat'l Bank Bldg., Waltham, Mass.
Barnes, William T. . . . . The Spring Brook Water Supply Co., 30 North Franklin St., Wilkesbarre, Pa.
Barney, Harold B. . . . . 18 Spooner Road, Chestnut Hill 67, Mass.
Bowers, George W. . . . . 359 Westford St., Lowell, Mass.
Brown, C. Leonard, The Argyle Apts., 17th, M and Park Road, Washington, D. C.
De La Haye, Elias F., Jr. . . . . 50 Perrins Steet, Roxbury, Mass.
Fuller, W. B. . . . . 1316 Washington Bldg., Los Angeles, Calif.
Green, Howard W. . . . . 383 So. Main St., Woonsocket, R. I.
Guiney, J. A. . . . . 22 Bennett St., Brighton, Mass.
Hannah, Thomas E. 70 Congress St., Fitchburg, Mass.
Johnson, Frank W., Care Raymond Concrete Pile Co., 140 Cedar St., New York, N. Y.
Johnson, George A. 150 Nassau St., New York, N. Y.
Lohmeyer, William, Capt., U. S. A. Hospital No. 28, Ward 65, Fort Sheridan, Ill.
McNulty, R. J. . . . . 49 Rosseter St., Boston 21, Mass.
Morrill, Frank P. . . . . Wise Rover, Mont.
Perkins, Clarence A. 22 Wilson Ave., Malden, Mass.
Rew, Morse W. . . . . 301 Falls St., Niagara Falls, N. Y.
Rich, B. A. . . . . . Care Lockwood, Green & Co., 245 State St., Boston, Mass.
Sampson, George A. 83 Pembroke St., Newton, Mass.
Socoll, J. M. . . . . Care Aberthaw Const'n Co., Box 868, Danville, Va.
Starr, John A. . . . . 100 Savin Hill Ave., Dorchester, Mass.
Wade, Clifford L. . . . . Care A. B. Drake, William St., New Bedford, Mass.
Warren, Henry E. . . . . 37 Temple St., Boston, Mass.
Wiggin, Thomas H. . . . . School Lane, Scarsdale, N. Y.

DEATHS.

Carr, Joseph L. . . . . February 12, 1920
Norcross, Orlando W. . . . . February 27, 1920
Olmstead, John C. . . . . February 24, 1920

PERSONAL NOTE.

William T. Barnes, M. Am. Soc. C. E., has withdrawn from the firm of Metcalf & Eddy, consulting engineers of Boston, to become chief engineer of the Spring Brook Water Supply Company which supplies Wilkesbarre, Pa., and vicinity.

Mr. Barnes was graduated from the Massachusetts Institute of Technology in 1893, and after a few years on railroad work in Indiana and on water-works construction with Rice & Evans, entered the employ of Leonard Metcalf, with whom, and his successor, the firm of Metcalf & Eddy, he has been ever since. In 1913 Mr. Barnes was admitted as a partner, and he was for about seven years in charge of the Chicago office of the firm.

In his new position Mr. Barnes will have charge of the design and construction of new works and of the technical maintenance and operation of the existing works, furnishing water to a population in excess of 300 000, including besides Wilkesbarre the cities and towns of Pittston, Plymouth, Kingston and Nanticoke, and a number of other smaller communities.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Boston Army Supply Base. Final Report of Fay, Spofford & Thorndike, Designing and Supervising Engineers. 2 vols. in manuscript and 5 vols. of blueprints.

Commercial Engineering. Report of a Conference on Business Training for Engineers. 1919.

Cotton Production and Distribution. Season 1918–19.

Mortality Statistics for 1918.

State Reports.

Massachusetts. State Department of Health. Annual Report for 1917.

Illinois. Consolidation of Local Governments in Chicago. 1919.

City and Town Reports.

Boston, Mass. Annual Report of Public Works Department for 1918.

Concord, Mass. Annual reports for 1919.

Danvers, Mass. Annual Report of Water Commissioners for 1919.

New York City. Development and Present Status of City Planning. 1914.

New York City. Establishment of Setbacks and Court Yards. 1917.

New York City. Report of Chief Engineer of Board of Estimate and Apportionment. 1917.

New York City. Final Report, Commission on Building Districts and Restrictions. 1916.

New York City. Building Zone Resolutions 1916 and amendments to July, 1919.

New York City. Height District Maps. Folio of 35 sheets. 1916.

New York City. Area District Maps. Folio of 35 sheets. 1916.

New York City. Use District Maps. Folio of 35 sheets. 1916.

(All of above reports relating to New York City are the gift of Mr. Thomas W. Clark, C.E., Brookline, Mass.)

New York City, The Transit Problems of. Discussion by Mr. D. F. Wilcox and others.

Northampton, Mass. Annual reports for 1918.

Rutland, Vt. Annual Report for 1919.

Miscellaneous.

American Society for Testing Materials. Vol. 19, Parts I and II. 1919.

Estimating Concrete Buildings, by Clayton W. Mayers. 1920. Gift of Aberthaw Construction Company.

Metropolitan Road and Rail Transit, by H. H. Gordon. Lecture before the Institute of Civil Engineers, London. 1919.

Production of Iron and Steel in Canada during 1918.

Library Committee.

Vol. VII MARCH, 1920 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

SMALL SEWAGE PUMPING STATIONS.

By Eugene F. Leger.*

(Presented before the Sanitary Section, February 11, 1920.)

Mr. Dorr has mentioned the fact that the small stations have occasioned operators some concern. They have also occasioned the manufacturer considerable concern sometimes.

Simply because a station is considered small is no reason to imagine that its problems are the more easily solved or that the equipment should be selected and installed indiscriminately. As a matter of fact, the reverse is generally the case. The larger station has a corps of men trained in the peculiarities of that station. Generally there are three shifts, so that there is constant attendance, and usually regulated means of screening the sewage, taking care of screenings, etc. Almost invariably, also, the equipment is in duplicate and sometimes in triplicate. The smaller stations, on the other hand, are often called upon to operate automatically and are practically devoid of any manual control or screening process, and are often installed in out-of-the-way places or sometimes in inaccessible places. All of these facts operate to make the proposition really more difficult in small than in large stations, and for that reason we believe even more care should be exercised in the selection of the apparatus and also in its location in the case of the small stations than in the larger stations, in spite of the fact that failure to operate, or failure of apparatus itself, might in the larger station cause considerably more damage than in the smaller.

---

* Of the Power Equipment Company, 131 State Street, Boston, Mass.

The subject might be divided into two general classes or methods of handling sewage, so far as the small stations are concerned, — one the pneumatic and the other the mechanical method. The pneumatic system in this country is not quite so popular as the mechanical, for reasons I will touch upon a little later. In speaking of the pneumatic system, I will just mention that it originated in England about forty years ago, when Isaac Shone installed a system for Eastbourne. Its net capacity was 2.5 m.g.d., and it was so very simple in construction that it is almost needless to describe it; but I think, for the benefit of some of the men not acquainted with the pneumatic system, I will describe it briefly.

The system was very successful, and resulted in about six or seven installations almost immediately after it had first proven satisfactory, and in 1886 the Houses of Parliament, confronted with the very serious problem of sewage removal, commissioned Mr. Shone to investigate and install a system for handling their sewage on the strength of what he had done at Eastbourne. The requirements of this contemplated installation read very much like the ordinary specifications in sewage stations to-day, but of course at that time they probably had a good many of the bidders "stumped."

In the first place, it was required that the apparatus be automatic in operation. The requirement was also made that the cost of operation should be appreciably less than any installation requiring attendance. It was required that the equipment should operate one hundred per cent. perfect, through what we consider even to-day a very wide range of capacities, — from 50 g.p.m. to over 1 000 g.p.m. It was also required to be foolproof in construction and with a minimum of working parts. To us to-day, of course, those things are perfectly obvious. We consider that anything different would not be acceptable. But when sewage pumping stations were in their infancy this was a pretty stiff proposition. However, the installation was made, and was such a remarkable success that one of the foremost medical journals, "The Lancet," cited it as having been conceived by genius. The type has been successfully used throughout the world since that time, with only minor changes with regard to air-valve control and floats and check valves. The apparatus consists of only a cast-iron pot and connections (Fig 1). This pot has an inlet pipe and an outlet pipe near the bottom. Both of these are provided with check valves, and the pot is supplied with an inlet pipe at the top, for compressed air. The sewage flows into the pot by gravity, the tank being vented to the atmosphere during the time of filling. The float control is the most important feature. It consists of two bells on a vertical shaft which extends through the stuffing-box at the top. The bottom float is nothing but a sink pan — open and always full of water or sewage. Higher up on the float rod

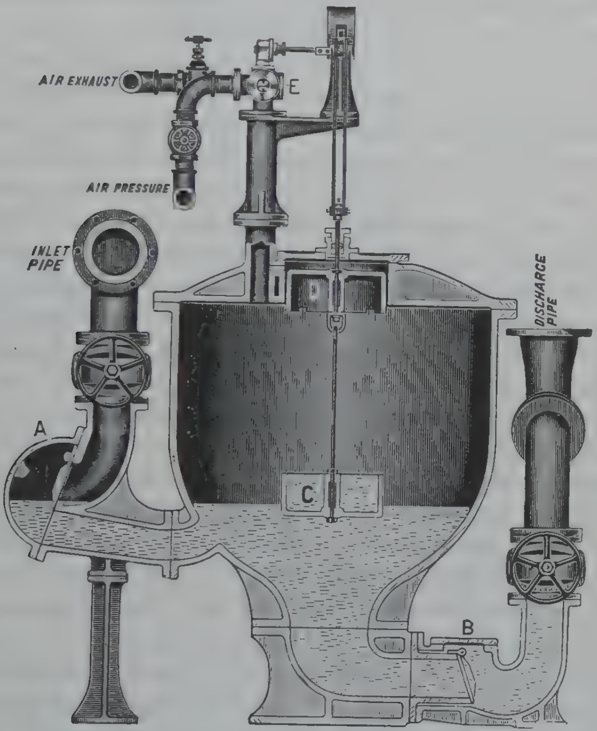


FIG. 1.—CROSS-SECTION OF SHONE EJECTOR.

is the inverted bell which serves as a positive float as soon as the water level, or sewage level, reaches the edge of the pan. The top float and bottom float are shown in the figure. As the sewage comes in, the bottom float becomes submerged, the buoyancy is immediately increased and affords a slight lifting effect to the valve mechanism on top. The sewage continues to rise, and as soon as it reaches the edge of the top float it traps the air in the float and exerts a powerful influence upon the valve at the top. This float is considerably better than the first ones used, because they were simply copper floats liable to puncture and likely to have rags hang on to them and destroy their buoyancy. This development has been made since the original installation, assuring more positive action and reliability. The sewage flows in, and when it reaches the top float the bell rises, — due to buoyancy, — trips the valve and admits compressed air and closes the vent to the atmosphere. The pressure closes the check valve in the suction line and opens the valve in the discharge, ejecting the sewage. Practically every bit of sewage in the pot is ejected at each stroke. As soon as the sewage leaves the pot the increased weight of the bottom sink pan operates to close the air suction valve and also vents the residual air to the atmosphere. The operation is intermittent, filling and discharging. The discharge stroke averages 5 to 10 seconds, and it is readily seen that anything which will flow in the pipes will be readily ejected. There are no moving parts, such as a piston or restricted areas. To our mind, this is the most simple method of handling sewage known. The cost of operation is almost four times what electrically driven centrifugal pumps cost, and for that reason it is not so universally accepted in the United States. The units are generally built in duplicate, so that the maximum capacity will generally exceed twice what the rated or nominal capacity would be.

The air for operating can, of course, come from any system of compressors in the building, or any system outside of the building. Where no such air is available, an automatically controlled compressor and tank is provided, which operates only as the demand makes it necessary. There are typical installations of this nature all over the world, — in Bombay, India, Africa and South America. In Boston they are installed in the Board of Trade Building, the Oliver Building and in six or eight other office buildings, — at Houghton & Dutton's, Filene's, the Copley-Plaza and the Essex Hotel; at Lynn, New Bedford, Fairhaven (entire equipment) and in one section of Providence. So their feasibility and usefulness has been absolutely proven, and the only objection that has been raised is that they are more expensive to operate than electrically driven plants. There are about 40 installations of this sort in the immediate vicinity of Boston.

The second or mechanical method covers any form of pump (reciprocating or centrifugal) and any form of drive (turbine, steam, belt or motor). But the most satisfactory type by far is the electric motor-driven centrifugal pumping unit, and the reason for that is obvious. We have to-day very positive complete and highly efficient methods of electrical control. We have electric motors which are as foolproof machines as can possibly be made. We have large central stations bidding for this very class of business, and large units behind them, so that the service is practically positive; and so far as the pump end is concerned the centrifugal pump eliminates all small valves with which one is confronted in the direct-acting pump. This method also eliminates the mass of gearing and possible breakage of the triplex type. Trouble from clogging, due to the ordinarily small passages maintained in centrifugal pumps as a type, was overcome most successfully about seventeen years ago, by Yeomans Brothers in Chicago. I believe the first successful automatic centrifugal sewage ejector was installed in Chicago seventeen years ago, and it is still in use there (Fig 2). It consists of a pot similar to the Shone pot with the single exception that two pumps are provided, both taking suction from the pot, the pot acting as a receiver and the sewage flowing to it by gravity. The two pumps are connected with individual valves so that each may be cut out of service for inspection or overhauling. The pot itself is provided with a cover which carries the automatic starting equipment and which carries the vertical motor, the vertical shafts extending up to any height or down to any depth that may be necessary. The ejectors are placed in the

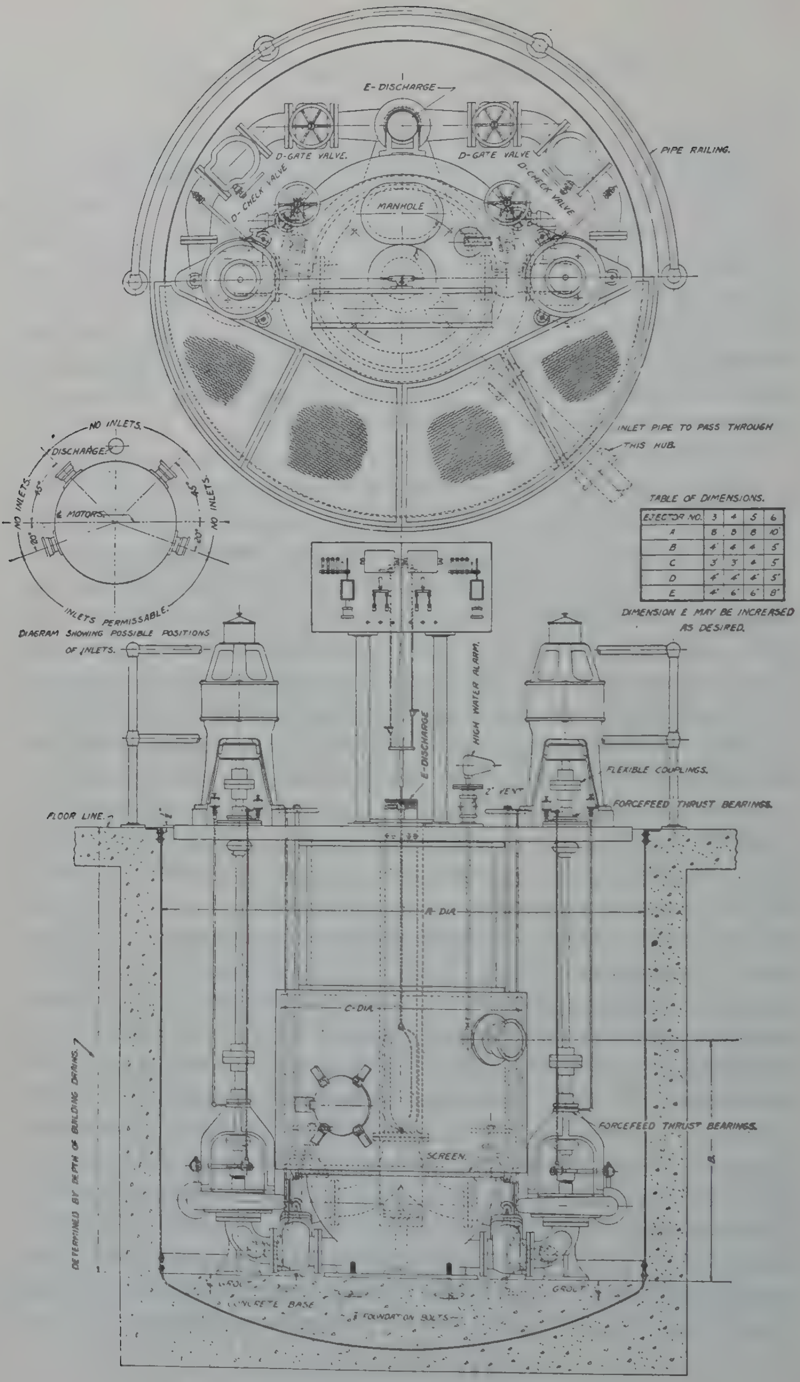


TABLE OF DIMENSIONS.

EJECTOR NO.	3	4	5	6
A	8	8	8	10'
B	4'	4	4	5
C	3'	3'	4	5
D	4"	4"	4"	5"
E	4"	6"	6"	8"

DIMENSION E MAY BE INCREASED AS DESIRED.

FIG. 2.—YEOMANS BROTHERS CO.—DUPLEX EJECTOR.

very lowest parts of the system so that the flow can be by gravity, and a copper float is encased in a pipe which keeps the sewage away from it. Similarly, rags, etc., are kept away from the float by encasing it in the pipe. The float rod carries two sets of tappets by which one pump is put in operation before the second, the idea being that one pump will handle all the sewage which normally flows into the pot and the second only be used in case of failure of the first, or in case of unusual flow, which is quite often the case. The pumps are of the single suction, vertical, open impeller type. These pumps are crude, however, compared with the high-grade water-works type of pump — and their ability to handle sewage is due to the fact that the passages are extremely large. The vanes are especially designed to cut or tear any rags or paper. Rags are always the bone of contention with centrifugal pumps. These vanes are designed with much different pitches and curves than in the ordinary centrifugal pump for handling water, to ensure shearing effect on rags. Each unit is provided with cut-out and check valve and the pot is provided with a grating near the bottom, which serves to catch sticks and larger particles which otherwise would normally find their way into the pump. The grating bars are never less than 1 in. and often 2 ins. apart. It is a fact also that the check valves in these electrically driven pumps are placed higher than the grating. The float starts the pump when the sewage reaches a predetermined level, and then cuts it out when another predetermined level is reached. Backflow is provided through the grating, to ensure a certain amount of water flowing back to dislodge rags, etc., from the grating, and the next charge is in an agitated condition for the pump to receive on its next start. This is considered almost absolutely necessary, because once a rag or piece of paper finds a seating on the grate it holds back a large amount of particles which otherwise would pass through the pump. The same piece of paper will often find its way through edgewise and get into the pump, where it will cause no trouble, whereas it might afford considerable trouble if left on the screen with the sewage piling on top of it. Practically no trouble has been experienced with this grating, and instances are unusual where it was necessary to clean the grating in unusually short periods. In many instances it has never been cleaned. In some instances milk-bottle stoppers and larger pieces of wood have been found on the grate. Manholes are provided in the casing, so that the grating may be cleaned. Periodic inspection is made, and it has always been shown that constant attendance is not necessary. This equipment is about as satisfactory as any which has ever been used in connection with the electrically driven type of sewage ejectors, and the fact that they have been installed in some of the largest buildings, as well as in a great many municipalities, is proof that they have always met the conditions in a thoroughly satisfactory manner, with a minimum of attendance. In a great many instances, oiling of the apparatus has been found on inspection to have been seriously neglected, simply because the man in charge has said, "Well, it runs," and consequently had never examined it or looked at it to find out why.

There is a duplex ejector of this type in Filene's basement which in one respect is very interesting. The unit is taking care of sewage — stools, etc. — at a lower level than any basement I know of — in fact, any basement about which any architect has ever consulted me. It is 73 ft. below the street level, and I think that will be a distinct surprise to most of the men here. This comprises one of the very interesting features of that installation. It has been in there ever since the building was built, and there has never been a word of complaint in regard to it. Also at the Lawton Mills there is an installation which is very interesting because of the material it has to handle. A number of different types of pumps were tried before this was installed, and since then it has given no trouble whatever. Some cities which have used this type are, Lenox; Norwood; Summer Street Extension, Boston; one section of Brookline; Fore River, Squantum (the largest of this type ever installed). This unit consists of duplex pumps, each being about 1 000 gals. per minute capacity, although never called upon to handle that amount. It is an automatic ejector and has never had an attendant other than the man to fill the oil cups. The cost of operation is about one fourth the cost of a pneumatic system.

To get down to what to me is more interesting than any of these, because these are so old, is the development that has been necessitated by the demand for increased efficiency. The above units are both more or less inefficient. The pneumatic system, of course, is the most inefficient, and the electric sewage ejector type is also inefficient, from the fact that the pump is single suction, crudely built, with large clearances. The demand has been for more efficient methods of handling sewage, and with that in view every effort has been made to improve the efficiency by the use of the enclosed type of impeller for handling sewage. The losses were due to defective packing between the discharge volute chamber and the suction volute. This is a direct loss, and much more so than the water lost in the slippage of pumps, because the water has been through the pump once and then if it leaks back into the suction again it is a direct loss, so that the centrifugal pumps of the most efficient types are provided with wearing rings, or packing rings, or labyrinth rings, etc., between the discharge volute chamber and the suction volute chamber, to prevent this loss by leakage. One manufacturer, in his centrifugal pump for handling water, provides a most efficient form of labyrinth packing ring, — a double tongue and groove ring, — and this is one reason he has been able to guarantee 83, 84 and 85 per cent. efficiency on large units. He has also developed a closed type of impeller, for handling sewage. Immediately the small running clearances became the weakest point of the pump. These clearances became clogged with matches, rags and what we call pigtails, — yarn skeins partly wound, — and practically stopped the pump. This was the first trouble experienced, in spite of the fact that it had been considered and the packing rings had deliberately been made with large clearances and the double tongue and groove construction abandoned for the flat ring. So the first trouble on the score of clogging was between the rotating impeller and the casing. These leaks come just between the stationary casing and the rotating impeller. To overcome this, rings of a threaded form were provided which are used to-day and were first used on the Metropolitan sewerage system at Clinton. In revolving, these rings have a rotary shear effect which has kept clean the passages between the rotating impeller and the casing.

The next trouble that developed was from rags wrapping themselves around the shaft, although a lower speed was used than for water-works pumps. This was overcome by the use of stationary sleeves, in addition to ordinary bronze sleeves for protecting the shaft. These extended well into the eye of the impeller — the entrance of the impeller — so that the particles, rags, etc., which came into the pump were prevented from winding round the shaft by these sleeves. Of course, normally more or less whirlpool action is set up without these sleeves. These stationary sleeves, and sewage wearing rings, were very successful so far as they went. Additional difficulty was encountered with rags larger than the minimum passages in the impeller, with the result that the impeller was absolutely clogged practically to the periphery at the discharge. As the inlet areas are always a little bit larger than the areas at the outlet, there are in all double suction pumps more or less wedge-shaped openings. The result was that rags passed into the eye of the impeller, clogged it and dammed things behind. This was partly overcome by providing the discharge volute with three nozzles drilled into the casing, pointed in a direction opposite to the direction of rotation of the pump and connected to city water, so that when the pump began to be clogged it was shut down for an instant and the operator turned on the nozzles which rotated the pump in the opposite direction, which cleared the pump, and eight times out of ten the rag causing the trouble found its way through. However, that did not solve all of the problems, and the final solution of the whole problem was a complete change in the method of screening. Now I am talking of manual control and diverting from small stations, because the small stations are automatically controlled. This situation is interesting, however, because it shows the trend in development for higher efficiency of sewage pumps. This particular plant was of interest because it represents a step forward and shows the process of development toward that end.

As I say, the change in screening was the real solution of the whole problem. They had been in the habit of raking the screen periodically. By careful comparison of the records of the Venturi meter with the records of raking, we found the pump began to lose capacity at the very time that those rakings took place. With this as a leader, and upon further investigations it was found as a matter of fact the raking of those screens permitted a great many rags to go through which had been caught on the screen and would normally have been taken off the screen; as it was, they passed into the pump, where with proper handling of the screens it could be prevented. So behind the regular inclined screens a second set of removable screens were dropped into place during periods of raking, to catch what would abnormally come through the first screens; and after finishing the raking, these screens were removed and simply turned backwards and cleaned with hose in a few seconds. The rakings were thrown into the suction pit and raked up with other matter. The screening problem is one, I am afraid, we are never going to get rid of if you insist on pumps of high efficiencies, because centrifugal pumps of double-suction enclosed impeller type will never have the capacity for rags, etc., that the open-type impeller has. It is expecting almost too much, I think, to hope for both maximum freedom from trouble and also maximum efficiency, and we can only look toward getting the best efficiency we can with the minimum attendance, and the question of screening is one I am afraid we are never going to get rid of completely, with centrifugal pumps.

The next plant that had serious trouble was at Swampscott, where horizontal pumps of double-suction type with stationary sleeves and enclosed type impellers are installed. Sewage is pumped from the suction reservoir, and when a level of approximately 2 ft. from the bottom is reached sludge which has been settling for a period of eight, ten or twelve hours is encountered. This gave serious trouble. It was sludge which would just flow through the pipes. In order to overcome this trouble the old vertical open impeller type of pump was retained, the idea being that pumps of high efficiency would be operated nine tenths of the time and the open impeller type one tenth of the time, when it was necessary to clean out extra heavy settled sludge. The high efficiency automatic control pumps were used for pumping down to a certain level and then stopped, the comparatively inefficient open-type impeller pump being used for handling the settled sludge.

At Brockton two antiquated reciprocating pumps had given no end of trouble, so three of the above type of unit were installed for handling, the city sewage, totaling about 3 m.g.d. It has increased since then. There is a reservoir of 500 000 gals. capacity, and during the interval of stoppage of the reciprocating pumps and the installation of the new unit the sewage settled in there for about eight months, due to delay on account of war conditions. The sewage settled for eight months in the 500 000-gal. reservoir, which was about 10 or 12 ft. deep, so when the first pump was installed and an attempt was made to lower the sewage to the point of normal pumpage, — about 2 ft. above the bottom of the reservoir, — very serious difficulty was encountered in getting the sewage out, much as at Swampscott. It was realized that the problem was a serious one, and one of the manufacturer's engineers was sent, with the idea of really learning something regarding the design of high-efficiency centrifugal pumps for that service. The result was the installation of an open-type impeller which was different from any open impeller I had ever seen, and was in fact an enclosed type, because the vanes were enclosed in walls, which makes it just as the name implies, an "enclosed type." The open type has bare vanes. The open type furnished at Brockton was one which was of vane construction, and yet there were provided stationary side plates to take the place of rotating side plates in the case of the closed type of impeller. This eliminated the wearing rings between the casing and the impeller and gave an open impeller with closed impeller features. The vanes acted as shears to cut rags, etc. That impeller was really remarkable. It handled stuff which surprised the Brockton authorities. The sewage commissioners were more than delighted with the manner in which the pump operated, and the efficiency was higher than the enclosed type which had been used for pumping relatively clear sewage. That particular feature of the open-type impeller with stationary side plates is the very latest, and, to my mind, the final solution of high-efficiency sewage pumps, with none of the disadvantages of shut-down for rags, clogging of impeller, etc. That impeller has handled the rawest and most crude forms of sewage imaginable.

The material passed was sufficient to stop the sprinkling filters. They considered their sprinkling filters about as efficient as any in the country, inasmuch as they had large nozzles capable of passing fairly heavy material which would ordinarily come to them. The system had to be shut down completely because of the unusually heavy material passing through the pump, which speaks pretty well for the pump. I believe if any one thing will eliminate troubles in the sewage pumping station it will be that type of pump with stationary shaft sleeves, to prevent rags from wrapping round the shaft; and the open-type impeller with stationary side plates, which combines the good features of the open type with the high efficiency of the closed type. Automatical control can still be maintained with such an impeller, if moderate screening facilities are provided. By "moderate" I mean screens of 2 ins. or 1½ ins. in mesh, which will catch stones, sticks, etc. Of course it can hardly be expected that any mechanical type will handle such things as that. We must go into the pneumatic type if this is necessary. The development of that particular type of pump was a very long process but a very satisfactory one. I believe we are going to see a number of good installations with that type of pump, even with the automatic control, where screening and where attendance is going to be at a minimum. Of course there is this about the double-suction pump, — the areas are never so large as with the single-suction type. However, the increased efficiency is well worth considering, and it simply remains to be seen what we are to do in the future as regards the supplying of automatic stations with this type impeller.

The only other station I want to mention is the Calf Pasture station at Boston, which I believe is the largest sewage pumping station in the country, having a capacity around 56 m.g.d. and two units. The pumps have recently been provided with the special features I have mentioned — that is, stationary sleeves and wearing rings to cut the material which might get into the small space between the rotating impeller and the casing. This was done recently after about eight years of continuous service, and we have been told that those features have helped considerably in the cleaning, etc., of the pumps.

I will try to show you the stationary sleeves and the wearing rings provided. Fig. 3 is a vertical cross-section of the pump. *A* is the suction volute and *B* the discharge volute. The water entering the suction goes through the impeller and is discharged in space *B*. The packing is between these two spaces, — the rotating impeller and the stationary casing. To pack against this leakage, labyrinth rings are provided, or flat wearing rings, with small clearance between them. The mate to the wearing ring is screwed on to the impeller, so that the water has to pass through *C* and break itself up once or twice in passing through the single tongue and groove. One manufacturer usually provides double tongue and groove. They operate with much larger clearances and less leakage. Some casings are provided with wearing rings of a flat nature, renewable, with threads cut on the flat surface, so that the tendency for any material coming into the suction, to get caught between, is eliminated. Clearances of from .03 in. to .04 in. are still maintained. The stationary shaft sleeves are simply let into the casing at *D*, to hold them stationary, and brought right up to the eye of the impeller and held there. The sewage is not brought in con-

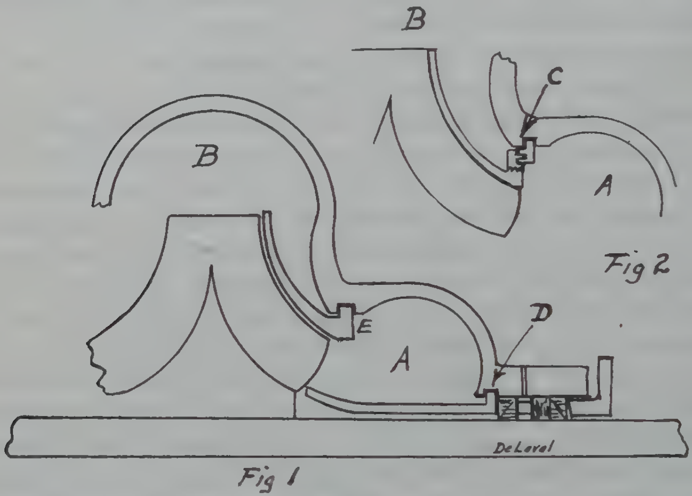


FIG. 3.—VERTICAL CROSS-SECTION OF PUMP, SHOWING SPECIAL FEATURES.

tact with the rotating shaft at all, but kept in a constant flow condition. Of course the eye of the impeller is always greater than the area at the tip, because there are relatively low velocities here and relatively high velocities at the periphery. It is a wedge-shaped construction. Any rags might become clogged and serve to plug the pump up. At Clinton, nozzles were drilled in the casing at various points around the volute, and they tended to clean out plugged parts. Of course that meant actual hand control. It meant a man had to be there all the time to clear them out. At Brockton this open-type impeller was used. At Brockton there were two 8-in. and two 10-in. pumps, of 1.5 m.g.d. capacity, 3.5 m.g.d., respectively. The shaft carries simply a vane impeller approximately this shape. The vanes are held together with a web between them, for rigidity. There is no means of providing for leakage by the vane. Leakage does take place, except that at Brockton they put in, instead of a wearing ring, a plate, which conformed to the shape of the impeller, which is stationary. This takes the place of the wearing ring, so that the impeller really rotates in a closed space. This feature gave no clearance, and there was no clearance along the side. That was one reason better efficiency was obtained than with the regular closed type, where the pressures are greater on one side than on the other. The leakage along the inside was practically negligible. They had actual contact and wore into place, so there was practically no chance for anything to get through *E*. The pump provided had stationary sleeves. Everything is in favor of getting sewage into that impeller. There is no point where rags will wrap around the shaft; no point where leakage can get by or plugging occur, except at the tip, and there it is a question of design. It is broad enough to pass any material which will come through the pipe. There is no reason why such impellers couldn't be adapted to double-suction vertical pumps also. I will say also that three impellers of different design were made before the right design was finally hit upon, so it was a little more than simply drawing up the impeller as sketched. The eye had to be brought out into the suction volute chamber to be sure the vanes would grab rags, etc. The material pumped was practically sludge, and was handled with a suction lift of over 23 ft., so I think we have a wonderful impeller in that particular design. When the level dropped to the last foot of the reservoir I think some 20 cartloads of coffee grounds and sand were left, which that pump had been handling. Three fire streams were used — the reservoir was 110 ft. long by 160 ft. wide — and the stuff washed into the suction pit of the pump. The invert of the sewer came into this reservoir, which had a pump pit at one end. The screens were built in a peculiar shape. They were built vertically spaced about 1½ ins. apart along a length of some 10 ft. in two stages to facilitate handling the racks, because the distance from ground level was about 15 ft. The first platform was arranged so that a man could stand at ground level and rake and then get down on another platform. A hoist and derrick were provided to pull the stuff up. The only trouble was to keep the screens free after putting the impeller into commission. So some bars were opened in order to get heavier stuff through and ensure the pump running, whereas it could never have run even with a dozen men on the screen keeping it clean. Due to the fact that the sewer came in at one level and the overflow was 2 ft. lower, during eight months we were pumping at a level almost equivalent to that of the overflow. Sounding bars showed 7½ ft. of solid sludge that a man could walk on, as the result of settlement. This stuff gave trouble with the impellers. Ladders were inserted through the manholes, with fire streams lashed to them, and squirted directly at the suction gate, and gradually worked that stuff ahead. We had a real problem in handling that sludge.

I don't know of any other pump that has been built with these particular features, even with the stationary sleeves along the shaft, or sewage wearing rings.

I am afraid I have deviated from the subject of small sewage pumping stations, but believe this will all tend toward the use of pumps of higher efficiency in automatic stations hereafter.

Incidentally, the pump at Brockton showed an efficiency of 76 per cent. The closed-type impeller showed 74 per cent. when they were handling practically water.

ADVERTISEMENTS

Vol. VII MARCH, 1920 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

INDEX TO ADVERTISERS.

	Page
A. B. See Electric Elevators, 111 Devonshire St., Boston	VI
Aberthaw Construction Co., 27 School St., Boston	XIV
Adams, H. S., 108 Ames Building, Boston, Mass.	V
Aspinwall & Lincoln, 3 Hamilton Pl., Boston	V
Associated Architects Printing & Supply Co., 144 Congress St., Boston	XIV
Bay State Dredging and Contracting Co., 62 Condor St., East Boston	XVIII
Beattie, Roy H., 10 Purchase St., Fall River	XIII
Bethlehem Steel Bridge Corporation, Bethlehem, Pa.	XVI
Bishop, J. W., & Co., 683 Atlantic Ave., Boston	VI
Blair, Isaac, & Co., Inc., 433 Harrison Ave., Boston	IV
Cleghorn Co., 54 Batterymarch Street, Boston	XIX
Coleman Bros., 1 Marginal St., Chelsea	XIII
Conant Machine Co., Concord Junction, Mass.	XIII
Donoghue, P. W., 170 Purchase St., Boston	XIX
Eastern Bridge and Structural Co., Worcester	XI
Fay, Spofford & Thorndike, 15 Beacon St., Boston	V
Fort Hill Press, 176 High St., Boston	XIV
Fuller, George W., 170 Broadway, New York	V
Gow, Charles R. Co., The, 166 Devonshire St., Boston	XII
Hall, John G., & Co., 114 State St., Boston	XIII
Holbrook, Cabot & Rollins Corpn., 6 Beacon St., Boston	VIII
Holzer, U., 25 Bromfield St., Boston	IX
Hughes, Edward F., 8 Oliver St., Boston	XIII
Jonsberg, F. F., Co., 733 Old South Building, Boston	XII
Kearns Co., W. F.	XX
Ledder & Probst, 144-150 Congress St., Boston	XIII
Ley & Co., Inc., Fred T., Springfield, Mass.	III
Main, Charles T., 201 Devonshire St., Boston	IV
Metcalf & Eddy, 14 Beacon St., Boston	V
New England Foundation Co., Inc., 70 Kilby St., Boston	XIII
New England Sand & Gravel Co., West Peabody, Mass.	IX
Old Corner Book Store, 27 Bromfield St., Boston	XIII
Palmer, John E., 1012 Old South Bldg., Boston	XIII
Penn Metal Co., 65 Franklin St., Boston	VI
Pennsylvania Cement Co., 161 Devonshire St., Boston	XII
Perrin, Seamans & Co., 57 Oliver St., Boston	IX

CONTRACTORS
LEY
SPRINGFIELD
MASS.

CAMP DEVENS WAS READY!

Army Cantonment at Ayer, Mass., Completed on Schedule Time

Demonstrating the Wisdom of awarding this Contract on a Cost Plus Percentage Basis

The 622 Buildings whose completion our schedule called for by September 1 were ready for the troops, and many of them occupied.

And 124 Buildings in Addition, including 46 of the 59 buildings needed for the 1,000-bed hospital unit, costing $500,000; refrigerating plants, storehouses, bakeries and miscellaneous buildings — all these completed ahead of schedule time.

Completing This $6,000,000 Contract on Schedule Time Necessitated:

- A Force of 9,000 Men
- A Weekly Payroll of $400,000
- $750,000 in Ready Cash
- Finishing One Building Every Forty Minutes for Two Months
- The Delivery of 30 Million Feet of Lumber
- Unloading 50 Carloads of Materials Daily
- Building a Complete Water Supply System with 20 Miles of Pipe
- Building a Complete Sewerage System with 20 Miles of Pipe

Capt. Canfield, in command of the Ayer Camp, informing us that Ayer headed the list of cantonments in percentage of completion, writes:

"This distinction should be a source of great gratification to your organization, as it is to mine."

FRED T. LEY & CO., Inc.

Contractors

BOSTON SPRINGFIELD NEW YORK

PAGE
RAYMOND CONCRETE PILE CO., 80 Boylston St., Boston XVII
RIDEOUT, CHANDLER & JOYCE, 178 High St., Boston XIII
ROCKPORT GRANITE CO., Rockport, Mass. VII
SEELEY & LAWSON, 73 Tremont St., Boston VI
SIMPSON BROS. CORPN., 166 Devonshire St., Boston VII
S-M-I ENGINEERING COMPANY, 136 Federal St., Boston V
SMITH, B. F., & CO., Merchants Bank Building 30 State St., Boston XIII
STONE & WEBSTER, 147 Milk St., Boston X
STUART, T., & SON CO., Newton, Mass. XVIII
THOMPSON, SANFORD E., 136 Federal St., Boston V
THORPE, LEWIS D., 201 Devonshire St., Boston V
TUCKER, EDWARD A., CO., 101 Milk St., Boston VII
WALDO BROTHERS AND BOND CO., 181 Congress St., Boston XI
WARREN FOUNDRY AND MACHINE CO., 111 Broadway, New York ... IX
WESTON & SAMPSON, 14 Beacon St., Boston V
WHITMAN & HOWARD, 220 Devonshire St., Boston V
WORCESTER, J. R., & CO., 79 Milk St., Boston V

GEO. A. BLAIR L. L. STREET W. O. WELLINGTON

ISAAC BLAIR & CO., Inc., General Contractors

Shoring and Moving Buildings a Specialty

433 Harrison Avenue, BOSTON

PROFESSIONAL CARDS

CHAS. T. MAIN

ENGINEER

201 Devonshire Street, Boston, Mass.

Rooms 817-833

Plans and Specifications for the erection and equipment or reorganization of textile mills and other industrial plants, including steam and water-power plants

H. S. ADAMS
Consulting Engineer
108-9 AMES BUILDING
BOSTON, MASS.

SANFORD E. THOMPSON
M. Am. Soc. C. E. M. Am. Soc. M. E.
Consulting Engineer
Design of Steel and Reinforced Concrete; Review of Plans; Estimates and Appraisals; Tests of Cement and Concrete; Organization of Construction and Industrial Work.
OFFICES AND LABORATORY
136 FEDERAL STREET, BOSTON

ASPINWALL & LINCOLN
Civil Engineers
3 HAMILTON PLACE
BOSTON

LEWIS D. THORPE
Civil and Sanitary Engineer
Water Works, Sewerage and Sewage Disposal
Supervision of Construction and Operation
201 Devonshire Street
BOSTON, MASS.

FAY, SPOFFORD & THORNDIKE
Consulting Engineers
BRIDGES AND OTHER STRUCTURES OF STEEL AND MASONRY. FOUNDATIONS. RIVER AND HARBOR WORKS
FREDERIC H. FAY CHARLES M. SPOFFORD
STURGIS H. THORNDIKE
15 Beacon Street, Boston, Mass.

WESTON & SAMPSON
ROBERT SPURR WESTON G. A. SAMPSON
Laboratory for the Analysis of Water, Sewage, Filtering Materials, etc., Design, Inspection and Supervision of Water Purification and Sewage Disposal Plants.
14 BEACON STREET, BOSTON, MASS.

GEORGE W. FULLER
M. Am. Soc. C. E. M. Am. Inst. Cons. E.
Consulting Hydraulic Engineer and Sanitary Expert
JAMES R. McCLINTOCK
Water Supply and Purification, Sewerage and Drainage, Disposal of Sewage and Refuse, Investigation of Epidemics, Public Utilities Valuations, Supervision of Construction and Operation.
170 Broadway, New York, N. Y.

WHITMAN & HOWARD
Civil Engineers
(Established in 1869)
220 Devonshire Street Room 504
BOSTON

J. R. Worcester E. E. Pettee G. H. Brazer
MEMBERS OF AM. SOC. C. E.
J. R. WORCESTER & CO.
Consulting and Designing Engineers
Bridges Foundations
Steel and Reinforced Concrete Construction
79 MILK STREET, BOSTON
Cement Testing Laboratory at Waltham, Mass

METCALF & EDDY
Leonard Metcalf Harrison P. Eddy
Charles W. Sherman Almon L. Fales
Frank A. Marston
CONSULTING ENGINEERS
Water Supply and Sewerage
14 BEACON ST. BOSTON, MASS.

S-M-I ENGINEERING COMPANY
REINFORCED CONCRETE AND STEEL ENGINEERS
S-M-I FLAT SLAB CONSTRUCTION. DESIGN OF REINFORCED CONCRETE AND STEEL. SUPERVISION OF CONSTRUCTION.
ESTIMATES
136 FEDERAL ST., BOSTON, MASS.

ROLLING STEEL SHUTTERS

COUNTERBALANCED ELEVATOR DOORS

SEELEY & LAWSON

73 TREMONT ST., BOSTON

HOLLOW METAL : DOORS AND WINDOWS : KALAMEIN

Telephone, Haymarket 3790

NEW YORK
101 Park Avenue

BOSTON
683 Atlantic Avenue

J. W. BISHOP COMPANY

GENERAL CONTRACTORS

PROVIDENCE
617 Butler Exchange

WORCESTER
109 Foster Street

---

48 Years of Service

METAL LATH
CONCRETE REINFORCEMENT
CULVERT PIPE

SHEET IRON AND STEEL BUILDING MATERIAL
OF EVERY NATURE

USE HAMPTON METAL
"IT WATCHES OTHERS RUST"

Penn Metal Company
65 Franklin Street
Boston, Mass.

SALES OFFICES
New York, N. Y. Portland, Me. Philadelphia, Pa.

FACTORIES
Boston and Cambridge, Mass.

A. B. SEE
ELECTRIC
ELEVATORS

Established 1883

ELECTRIC ELEVATORS OF ALL TYPES

OFFICES
New York
Boston
Hartford
Jersey City
Philadelphia
Washington
Baltimore
Cleveland
Montreal
Toronto

WORKS
Jersey City
New Jersey

Montreal
Canada

BOSTON OFFICE
Minot Building
111 Devonshire St.

SIMPSON BROS. CORPORATION

TRADE MARK REG.
LAID BY SIMPSON BROS.
CORPORATION
166 DEVONSHIRE ST.
BOSTON

ENGINEERS AND CONTRACTORS
FOR
REINFORCED CONCRETE
CONSTRUCTION

ROCK ASPHALT FLOORS — GRANOLITHIC FLOORS.
SIDEWALKS, CURBING, STEPS, BUTTRESSES, ETC.
SIMBROCO CONCRETE STONE BUILDING TRIM.
HASSAM CONCRETE STREET PAVEMENT.

ROCKPORT GRANITE
permanently resists all action of Sea Water

It is an undeniable fact that chemical changes take place in the cement of CONCRETE construction exposed for any number of years to sea water, changes that are certainly not for the better.

No changes take place in Rockport Granite. It is permanent, and it is impermeable; and these FACTS are beyond question. The same facts apply to masonry work of every description — Rockport Granite is the ONE material of PERMANENCY.

A combination of Quality and Low Price is offered in Rockport Granite, full details of which will be supplied upon request. Write.

ROCKPORT GRANITE CO. - Rockport, Mass.
C. HARRY ROGERS, Treas. and Gen'l Mgr.

Branch Offices
Boston, New York City, Chicago, Detroit, Cleveland and Philadelphia

EDWARD A. TUCKER COMPANY
Concrete Engineers

Designs and Estimates Submitted for Concrete Reinforcement — Monotype Deformed Bars — Spirals — Metal Forms

CONVERSE BUILDING, 101 MILK STREET, BOSTON
Direct Mill Connections
Warehouse, Cambridge
Shop, Camden, N. J.
Telephone, Fort Hill 1840

Holbrook, Cabot & Rollins Corp'n

Contractors

Heavy Masonry and Concrete Construction, Deep Foundations

6 BEACON STREET BOSTON, MASS.

52 Vanderbilt Avenue
New York, N. Y.

JAMES W. ROLLINS, President
FREDERICK HOLBROOK, Vice-President
WILLIAM S. PATTEN, Vice-President
THOMAS B. BRYSON, Secretary and Treasurer

NEW ENGLAND SAND AND GRAVEL CO.

PEABODY 244 WEST PEABODY, MASS.

SCREENED, SIZED AND WASHED

BANK SAND AND GRAVEL

ONE CAR OR A TRAINLOAD

CONCRETING, GRANOLITHIC AND ROOFING GRAVEL
BUILDING AND CONCRETE SAND

PROMPT AND RELIABLE SERVICE

WARREN FOUNDRY AND MACHINE CO.

MANUFACTURERS OF

Cast Iron Gas and Water Pipe

FLANGE PIPE SPECIAL CASTINGS

201 Devonshire St.,
BOSTON, MASS.

SALES OFFICES

11 Broadway,
NEW YORK

PERRIN, SEAMANS & CO.

Machinery, Tools and Supplies
FOR
Construction Work

57 OLIVER STREET, BOSTON

U. HOLZER,

BOOK-BINDER

25 BROMFIELD ST., BOSTON, MASS.

ESTABLISHED 1870.

All kinds of Books bound and repaired.
Maps and Charts mounted.
Portfolios, Scrap Books, Blank Books, etc., made to order.
Lettering in Gold; Paper-Splitting; Inlaying; etc.
Photographs Mounted on Card or Paper without Cockling.

Telephone
and
Elevator

STONE & WEBSTER

FINANCE public utility developments.

BUY AND SELL securities.

DESIGN steam power stations, hydro-electric developments, transmission lines, city and interurban railways, gas plants, industrial plants and buildings.

CONSTRUCT either from our own designs or from designs of other engineers or architects.

REPORT on public utility properties, proposed extensions or new projects.

MANAGE railway, light, power and gas companies.

NEW YORK BOSTON CHICAGO

EASTERN BRIDGE
— AND —
STRUCTURAL CO.

Worcester, Massachusetts,
For Prices on all Classes of

STEEL AND IRON WORK.

WE DESIGN AND MANUFACTURE
ROOF TRUSSES, GIRDERS, COLUMNS, STAIRS
AND FIRE ESCAPES FOR BUILDINGS . . . .

FOOT BRIDGES, HIGHWAY BRIDGES, RAILROAD BRIDGES

We Carry a Large Stock of
I-BEAMS, PLATES AND ANGLES

Can Make Quick Deliveries. Send in Your Inquiries.

WALDO BROS. AND BOND COMPANY

Building Material and
Construction Equipment

181 CONGRESS STREET, BOSTON, MASS.

F. F. JONSBERG CO.

Engineering Construction

Switch Cell Construction

733 OLD SOUTH BUILDING
BOSTON

THE EXTREME HIGH QUALITY OF

PENNSYLVANIA PORTLAND CEMENT

MAKES ITS USE ESSENTIAL WHERE
WORK OF THE HIGHEST CLASS IS DESIRED

PENNSYLVANIA CEMENT CO.

NEW YORK OFFICE
30 East 42d St.

BOSTON OFFICE
161 Devonshire St.

THE CHARLES R. GOW COMPANY

Contractors for Engineering Construction

No. 166 DEVONSHIRE STREET

BOSTON, MASS.

EDWARD F. HUGHES
Artesian and Driven Wells
for
Manufacturing, Public or Private
Water Supply
954 Oliver Building, 8 Oliver Street, Boston, Mass
TEL. 1633 MAIN

SCIENTIFIC BOOKS
AND PERIODICALS

THE OLD CORNER BOOK STORE
27-29 Bromfield Street
BOSTON, MASS.

Gravel – Sand – Crushed Stone
LOADING MACHINES
For Sale and Rent to
Contractors, Road Builders,
Sand and Gravel Dealers . .
BUILT BY
CONANT MACHINE CO.
Concord Junction, Mass.
Write, call or phone, for information, prices and circulars

JOHN G. HALL & CO.
114 STATE STREET, BOSTON
=PILING=

JOHN E. PALMER
Contracting Engineer
Contractor for Sewers, Water Works,
Concrete Bridges, Concrete
Foundations, etc.
Room 1012, Old South Building
Boston, Mass.
Telephone, Fort Hill 1731

LEDDER & PROBST, Inc.
144-150 CONGRESS ST., BOSTON, MASS
Surveying Instruments
REPAIRING
BLUE AND BLACK PRINTS
Drawing Materials

C. D. Kirkpatrick, *Mgr.* S. P. Gates, *Asst. Mgr.*
B. F. SMITH & CO., INC.
ESTABLISHED 1878
ARTESIAN AND DRIVEN WELLS
FOUNDATION BORINGS
Engineers and Contractors for Municipal and Private
Water Works
Office: MERCHANTS BANK BUILDING
30 STATE STREET, BOSTON, MASS.

RIDEOUT, CHANDLER & JOYCE
Engineers and Piping Contractors
178 HIGH STREET - BOSTON, MASS.

Steam Specialties, Engineers' Supplies
Piping of All Kinds Furnished or Erected

New England Foundation Co., Inc.
Engineering and Construction
Simplex Concrete Piles
70 KILBY STREET :: :: BOSTON, MASS.

ROY H. BEATTIE
Harbor Improvements
Divers :: Lighters
10 PURCHASE STREET
FALL RIVER, MASS.

COLEMAN BROS.
General Contractors

Main Office
1 Marginal St.,
Chelsea

Boston Address
166 Devonshire St.

Associated Architects Printing & Supply Co.

144 CONGRESS STREET, BOSTON

BLUE, BLACK AND VANDYKE PRINTING ON PAPER OR LINEN
BLACK ON WHITE REPRODUCTION PROCESS—ANY COLOR
DRAWING MATERIALS AND SUPPLIES

TELEPHONE, FORT HILL 4013

ESTABLISHED 1881

The Fort Hill Press

Our Motto
Quality and Service

SAMUEL USHER

BOOK : JOB : MAGAZINE : CATALOGUE
SCHOOL : LAW

PRINTING

DESIGNING ENGRAVING

TELEPHONE CONNECTION

176 TO 184 HIGH ST., BOSTON

Knowledge of

Engineering Design
Estimating
Planning of Operations
Purchase and Supply
Labor and its Right Guidance
Cost Accounting
Essential Control

Combined in a single homogeneous organization, adequately financed, is the

POWER behind ABERTHAW ACCOMPLISHMENT

ABERTHAW CONSTRUCTION COMPANY

BOSTON MASSACHUSETTS

ATLANTA PHILADELPHIA BUFFALO

6-94

Contractors who helped to build the Boston Army Supply Base

W. F. Kearns Company

The Raymond Concrete Pile Company

Bay State Dredging and Contracting Company

The Cleghorn Company

P. W. Donoghue

General Electric Company

T. Stuart & Son Company

Bethlehem Steel Bridge Corporation

BETHLEHEM, PA.

Design Fabricate Erect

STEEL BRIDGES

and other Steel Structures

OFFICES:

NEW YORK, N. Y.
111 Broadway

BOSTON
141 Milk Street

PHILADELPHIA
Morris Building

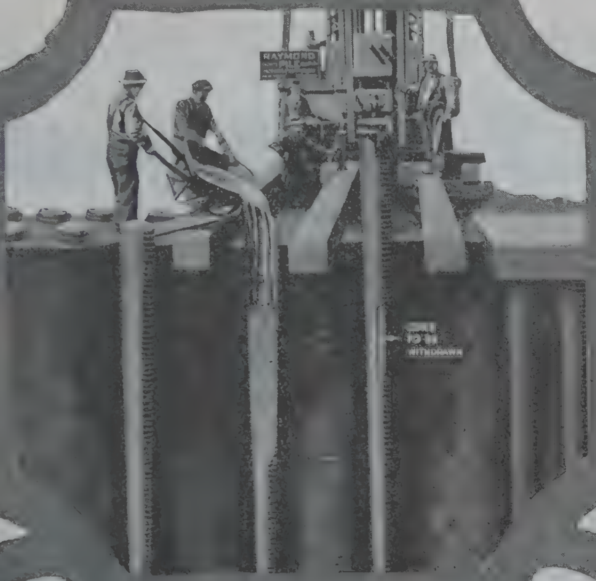
ATLANTA
Candler Building

PITTSBURGH
First Nat. Bank Bldg.

CLEVELAND
1525 Guardian Bldg.

CHICAGO
Peoples Gas Bldg.

SAN FRANCISCO
Monadnock Bldg.



THE
RAYMOND METHOD
of
Concrete Pile Installation

was chosen by the Engineers for the ARMY SUPPLY BASES at BOSTON, NEW YORK and NEW ORLEANS, because it makes absolutely certain that each and every concrete pile is perfect. A spirally reinforced steel shell is driven by a driving core, or mandrel. The core is then collapsed and withdrawn, leaving the shell in the ground. The interior of this shell may then be inspected; and finally the concrete is poured into it, the shell remaining in place to protect the pile column. ¶ We also construct Special Reinforced Concrete Work of every description: Shipbuilding, Ways, Docks, Bridges, Retaining Walls, Piers, Ore Handling Structures, etc.

RAYMOND CONCRETE PILE COMPANY
NEW YORK: 140 Cedar Street CHICAGO: 111 W. Monroe Street
MONTREAL, CANADA: Raymond Concrete Pile Co., Limited
BOSTON: 80 Boylston Street
A Form for Every Pile *A Pile for Every Purpose*

T. Stuart & Son Company

General Contractors

NEWTON, MASSACHUSETTS

Bay State Dredging & Contracting Co.

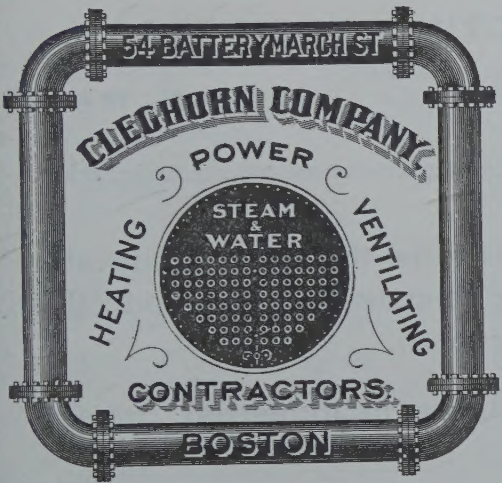
Contractors

River and Harbor Improvements, Sea Walls, Breakwaters, Heavy Masonry Construction.

62 Condor St., East Boston, Mass.

JAMES E. CASHMAN, Treas.
GORHAM H. WHITNEY, Prest. DAVID J. WHITE, Sec'y—Gen. Mgr.

The Cleghorn Company



Telephone 1546 Main

have installed the entire power, heating and ventilating plant at the **Boston Army Supply Base**

6 400-H.P. Boilers and Accessories
2,200 Radiators
6,600 Valves
70,000 Fittings
225,000 ft. of Pipe

besides a station for the Temporary Warehouses completed in 40 days.

P. W. DONOGHUE

Plumbing Contractor

FOR THE

$28,000,000
Boston Army Supply Base

170 Purchase Street
BOSTON, MASS.

Telephone: Fort Hill 4974

KEARNS CONSTRUCTION COMPANY

CONSTRUCTING ENGINEERS

153 MILK STREET - - - BOSTON, MASS.

1920 promises to be the most remarkable building construction period this country has ever known.

Tremendous activity in industrial projects is already evident.

Present conditions fail to indicate any downward trend in building costs.

We suggest early consideration of anticipated operations by prospective owners.

We were the pioneers and are still the leaders in reinforced concrete construction.

We place at your disposal KEARNS SERVICE, backed by the experience of more than twenty-five years of successful building.

KEARNS SERVICE MEANS THE BEST IN INDUSTRIAL BUILDING CONSTRUCTION

SPECIAL COMMITTEES

ON THE LIBRARY

S. EVERETT TINKHAM, Chairman

GORDON M. FAIR
HOWARD B. LUTHER
FRANK A. MARSTON
BARZILLAI A. RICH

ON MEMBERSHIP

HARRY F. SAWTELLE, Chairman

WM. W. BIGELOW
LEROY G. BRACKETT
ARTHUR C. KING
THOMAS F. McSWEENEY
CHAS. R. MAIN
THORNTON R. STENBERG
PHILIP W. TAYLOR

ON PUBLICATION

STURGIS H. THORNDIKE, Chairman

SANFORD E. THOMPSON
ARTHUR S. TUTTLE

ON PAPERS AND PROGRAM

LEONARD METCALF, Chairman, ex officio

JOHN B. BABCOCK, 3d
JOHN E. CARTY
LUZERNE S. COWLES
JOHN R. NICHOLS
REEVES J. NEWSOM
GEORGE E. RUSSELL
SANFORD E. THOMPSON
S. EVERETT TINKHAM
DANA M. WOOD

ON SOCIAL ACTIVITIES

CHARLES R. BERRY, Chairman

ARMAND W. BENOIT
ANTHONY S. COOMBS
HARRISON P. EDDY, Jr.
RALPH W. HORNE
ANGUS B. MACMILLAN
DAVID SUTTON
PHILIP B. WALKER

RATES FOR ADVERTISEMENTS

For one year — 10 issues

One page	$75.00
One-half page	40.00
One-quarter page	25.00
One-sixth page	17.50
One-eighth page	14.00
One-twelfth page	10.00

Last page, 50 per cent. additional.

For further information, or for contract forms, address
WILLIAM L. BUTCHER, Editor,
715 Tremont Temple, Boston.

SAMUEL USHER
BOSTON